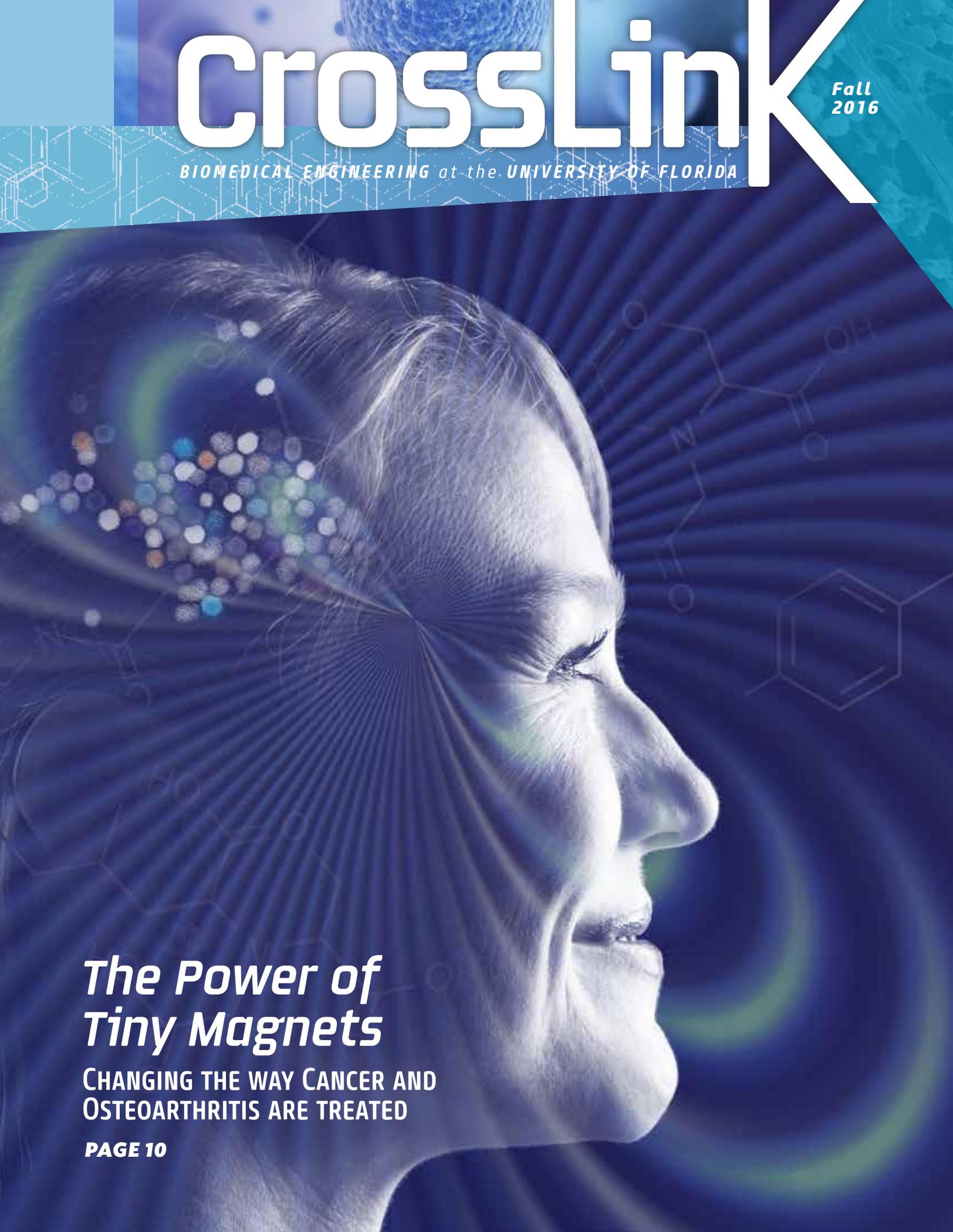


CrossLink

Fall
2016

BIOMEDICAL ENGINEERING at the UNIVERSITY OF FLORIDA

A woman's profile is shown in a blue-tinted, high-contrast style. Overlaid on her head is a brain scan visualization with colorful dots. The background features faint chemical structures and a grid pattern.

The Power of Tiny Magnets

CHANGING THE WAY CANCER AND
OSTEOARTHRITIS ARE TREATED

PAGE 10

**\$50 MILLION GIFT
TO CATALYZE A
\$300 MILLION
TRANSFORMATION**

Dr. Herbert and Nicole Wertheim are leading a new movement to transform engineering education and research at the University of Florida to change the world. Their \$50 million gift will lead to a \$300 million impact, going far past the walls of our university, spearheading the next great era of engineering innovation.

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COLLEGE of ENGINEERING**

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Christine E. Schmidt, Ph.D.

Pruitt Family Professor & Department Chair

Dear UF BME Friends & Family;

Welcome to the third annual issue of CrossLink, a publication of the J. Crayton Pruitt Family Department of Biomedical Engineering. This past year has been, in many respects, remarkable!

Most notably from this past year, we are proud to announce the Herbert Wertheim College of Engineering! Dr. Herbert & Nicole Wertheim gave the largest cash gift in UF's history in support of engineering education and research. Their \$50 million catalyst gift launched a \$300 million public and private fundraising initiative that is transforming the college, and the future by:

- Adding engineering faculty and building interdisciplinary frameworks
- Creating new learning and research spaces
- Advancing innovation in engineering education

Like the college, our department is experiencing tremendous growth. UF BME placed 15th among public school institutions in the U.S. News & World Report's Best Graduate School Rankings, climbing an amazing seven spots in a single year over our 2015 rank. This continues the upward trend for the department, which has climbed 18 spots in the past four years.

We have focused recently on recruiting distinguished faculty to our program, including seven faculty hires (six tenure track faculty and one teaching faculty) in just the past three years. In addition, this coming year, we are delighted to welcome Dr. Edward Phelps, who will join the department as an assistant professor starting January 2017 (please see p. 8 to learn about Dr. Phelps).

In line with providing the best academic experience for our students, this past year we made significant changes to our leadership structure, highlighted below. Our goal is to create a broader-based distributed leadership model, which allows us to meet the needs of our increasing student body while continuing to be visionary and strategic. I am also excited about our new director position for BME Graduate Student Diversity & Professional Development. Through this position we will host important programmatic and networking activities to promote social awareness and inclusion while providing valuable professional skills for success.

- Senior Associate Chair – Dr. Carlos Rinaldi
- Associate Chair for Graduate Studies – Dr. Cherie Stabler
- Associate Chair for Undergraduate Studies – Dr. Kyle Allen
- Undergraduate Coordinator – Dr. David R. Gilland
- Director for BME Graduate Student Diversity & Professional Development – Dr. Brandi Ormerod
- ABET Coordinator – Dr. Stephen Arce

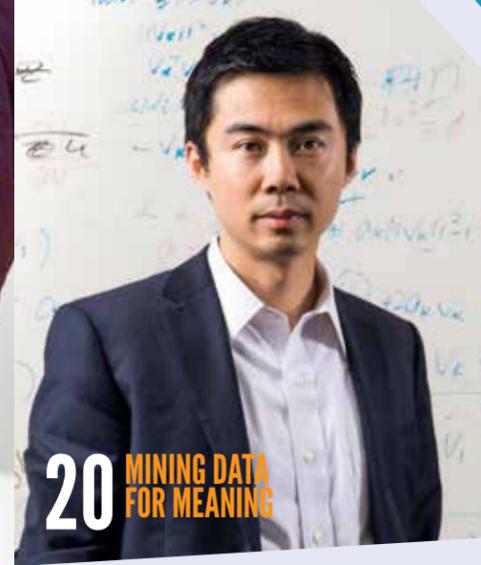
In addition, BME faculty member and former associate chair, Dr. Hans van Oostrom, was named founding director of the UF Institute for Excellence in Engineering Education at the college. The new institute was formed as part of the Wertheim agreement and the college's commitment to fostering excellence in engineering education, and is funded by a \$1M annual commitment from the Provost as part of the university match to the Wertheim gift.

As I reflect on this past academic year, I am humbled to be a part of this incredible community of scholars. There is exceptional energy here at UF!

Warmest regards,



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CrossLink

A publication of the J. Crayton Pruitt Family Department of Biomedical Engineering at the University of Florida

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UF BME Faculty Snapshot



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PET and SPECT



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functional implants and organ regeneration



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physics and dose assessment



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Ph.D., University of Wisconsin
Nanomaterials engineered to direct
immune responses for disease
prophylaxis, implants and
immunotherapies



EDWARD PHELPS
Assistant Professor (Jan. 2017)
Ph.D., Georgia Institute of Technology
Cell and tissue regeneration, islet biology,
diabetes immunopathology



HANS VAN OOSTROM
Associate Professor & Director, Institute
for Excellence in Engineering Education
Ph.D., Eindhoven University of Technology
Human physiologic simulation to enhance
noninvasive patient monitoring and education



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Ph.D., University of Maryland
Cognitive neuroscience, multivariate
signal processing and multimodal
neural imaging



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Ph.D., Dartmouth College
Optical, fluorescence and photoacoustic
tomography and microscopy



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Ph.D., Washington State University
Machine learning, data mining, big
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Ph.D., Rutgers University
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vision and computer aided diagnosis



JON P. DOBSON
Professor
Ph.D., Swiss Federal Institute of Technology,
ETH-Zurich
Magnetic micro- and nanoparticle-based
biomedical applications



BENJAMIN G. KESELOWSKY
Associate Professor &
UF Research Foundation Professor
Ph.D., Georgia Institute of Technology
Biomaterials and controlled release systems
for vaccines, immunotherapies and implants



CARLOS RINALDI
Charles A. Stokes Term Professor
& Senior Associate Chair
Ph.D., Massachusetts Institute of Technology
Nanomedicine, cancer nanotechnology,
magnetic nanoparticles and transport
phenomena

ENGINEERS for LIFE.

News & Notables

UF BME COLLABORATIVE COMMUNITY



3 Hospitals

30+ Departments, Centers & Institutes



7 Colleges

21 Core Faculty

70+ Affiliate Faculty

UF BME Welcomes Dr. Edward Phelps!

Phelps will join the department as an assistant professor starting January 2017, focusing his expertise on biomaterials, regenerative medicine and immunoengineering.

Before coming to UF BME, Phelps was a postdoctoral fellow at the School of Life Sciences and the Institute of Bioengineering at the Swiss Federal Institute of Technology in Lausanne (EPFL), Switzerland. He received his B.S. in biomedical engineering from the Georgia Institute of Technology in 2006, and Ph.D. in bioengineering from the Georgia Institute of Technology in 2011 under the guidance of Dr. Andrés García, the Neely Endowed Chair and Regents' Professor in Mechanical Engineering. Phelps' thesis work focused on engineered bioactive materials for therapeutic angiogenesis and pancreatic islet transplantation for which he received the 2011 Georgia Tech Bioengineering Program Best Ph.D. Thesis Award.

Phelps will collaborate with the UF Diabetes Institute, an international leader in investigating the history, prediction and prevention of Type 1 diabetes. Under the direction of Dr. Mark A. Atkinson, the UF Diabetes Institute serves as the umbrella organization under which diabetes education, research and treatment are coordinated at UF and the academic Health Science Center.



Dr. Aysegul Gunduz receives prestigious NSF CAREER Award

for her research investigating the neurophysiology of Tourette syndrome by developing responsive deep brain stimulation systems for improved and targeted treatment.



MAJOR FACULTY AWARDS AND RECOGNITIONS

- Dr. Jon Dobson elected AAAS Fellow
- Dr. Mingzhou Ding appointed Associate Editor of *The Journal of Neuroscience*
- Dr. Benjamin Keselowsky invited to serve on the Biomaterials and Biointerfaces Study Section for the NIH Center for Scientific Review
- Dr. Benjamin Keselowsky appointed Associate Editor of the *Journal of Nanomedicine: Nanotechnology, Biology and Medicine*
- Dr. Peter McFetridge awarded Tim Brahm Term Professorship
- Dr. Kevin Otto selected as co-Chair for the 2017 BMES Annual Meeting
- Dr. Christine Schmidt organized the 25th anniversary 2016 AIMBE Annual Event
- Dr. Hans van Oostrom named Founding Director of the Institute for Excellence in Engineering Education

KEY RESEARCH ADVANCES & INNOVATION

- Dr. Kyle Allen, Dr. Jon Dobson and Dr. Carlos Rinaldi awarded \$1.5M collaborative R01 grant from NIAMS for "Magnetic Capture of Osteoarthritis Biomarkers"
- Dr. Aysegul Gunduz and collaborators awarded \$1.75M R01 grant from NINDS for "The Human Thalamocortical Network in Tourette Syndrome"
- Dr. Gregory Hudalla featured in *Journal of Materials Chemistry B: Emerging Investigators* 2016 issue
- Dr. Parisa Rashidi and team awarded \$2.3M R01 grant from NIH for "Integrating data, algorithms and clinical reasoning for surgical risk assessment"
- Dr. Blanka Sharma awarded \$1.2M grant from the Florida Department of Health James and Ester King Biomedical Research Program for "Nanoparticle-based targeting of miR183 for immunotherapy of lung cancer"
- Dr. Cherie Stabler awarded \$1M collaborative grant from the Juvenile Diabetes Research Foundation for "Engineered Bioactive Hydrogel Macrodevices for Islet Transplantation"

STUDENT AWARDS

- Shruti Siva Kumar won 2015 GE Industrial Remix Challenge
- Edmond Olguin awarded 2016-17 Robert Gardner Memorial Fellowship
- Jonathan Shute awarded NIH T32 Fellowship
- Benjamin Spearman awarded NSF Graduate Research Fellowship
- Troy Templin and team won 2nd place at 2015 International Contest of Applications in Nano/Micro Technologies (iCan)
- UF BME students awarded 1st (Heather Petroccia), 2nd (Brendan Barraclough) and 3rd (Emily Marshall) place at Florida Chapter of the American Association of Physicists in Medicine 2016 Annual Conference



UF BME Graduate Program ranked 15th among public universities by U.S. News & World Report, representing an 18 spot climb since 2013

Distinguished Leadership Seminar Series

2015-2016 SPEAKERS



Dr. Kristi S. Anseth
Howard Hughes Medical Institute Investigator and Distinguished Professor of Chemical and Biological Engineering, University of Colorado Boulder
Cellular Control in a Couple of Clicks



Dr. Scott P. Bruder
Principal, Bruder Consulting International, LLC and Adjunct Professor of Biomedical Engineering, Case Western Reserve University
Innovation Competency and the Path to Successful Commercialization



Dr. Dominique Durand
EL Lindseth Professor of Biomedical Engineering and Director, Neural Engineering Center, Case Western Reserve University
Can Neural Activity Propagate by Endogenous Electrical Field?



Dr. Matthew O'Donnell
Frank and Julie Jungers Dean Emeritus, College of Engineering and Professor of Bioengineering, University of Washington
Molecular Theranostics with Integrated Photoacoustics/Ultrasound



Dr. Jennifer L. West
Fitzpatrick Family University Professor of Engineering, Duke University
Biomimetic Patterning to Control Cell Behaviors

2016-2017 SPEAKERS



Dr. Rashid Bashir
Abel Bliss Professor of Engineering and Bioengineering Department Head, University of Illinois at Urbana-Champaign



Dr. Tejal Desai
Professor and Chair of Bioengineering and Therapeutic Sciences, Schools of Pharmacy and Medicine, University of California, San Francisco



Dr. David Kaplan
Stern Family Professor of Engineering and Chair of Biomedical Engineering, Tufts University



Dr. Robert F. Kirsch
Allen H. and Constance T. Ford Professor and Chair of Biomedical Engineering, Case Western Reserve University



Dr. Nicholas A. Peppas
Cockrell Family Regents Chair in Engineering, Professor of McKetta Department of Chemical Engineering, Professor of Biomedical Engineering, University of Texas at Austin



Dr. Lori A. Setton
Lucy and Stanley Lopata Distinguished Professor of Biomedical Engineering, School of Engineering and Applied Science, Washington University in St. Louis



The Power of Tiny Magnets

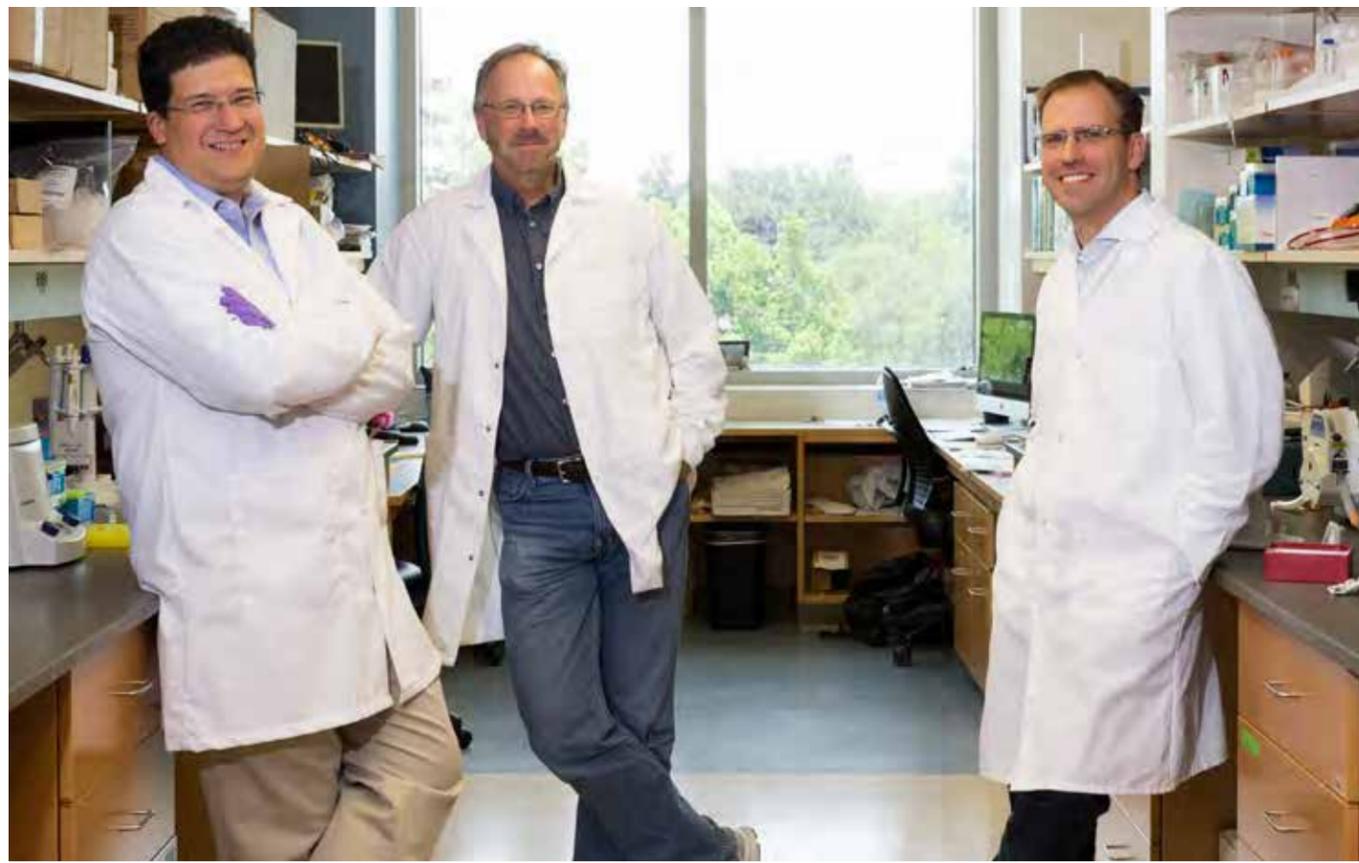
*Changing the Way Cancer and
Osteoarthritis are Treated*

by
April Frawley Lacey

Google the phrase “uses for magnets” and you will find helpful hints to keep your trash bags in place or locate missing earrings. Rebuilding cartilage and obliterating breast cancer tumors aren’t on the list

...yet.

The use of magnetic iron oxide nanoparticles in targeted drug delivery studies dates back to the 1970s, but the past decade has been somewhat of a renaissance for the use of these tiny particles, which are 1 million times smaller than an ant. Because these particles have long been safely used in the body, they make ideal tools for researchers trying to devise new and better treatments for conditions such as cancer, osteoarthritis and even cystic fibrosis.



Leaders in UF's research on magnetic nanoparticles: Carlos Rinaldi, Ph.D., Jon Dobson, Ph.D. and Kyle D. Allen, Ph.D.

Imagine using a remote control to be able to target a tumor or activate tissue to begin regenerating. Using magnetic nanoparticles is sort of like that.

Like little ninjas, magnetic nanoparticles can wait in cells for their orders from scientists, who use magnetic fields outside the body to guide their nano-sized soldiers into action.

"Magnetic nanoparticles are basically tiny magnets. Every child has played with magnets. You can use one to move the other; you can push them and pull them and rotate them. They're exciting from a scientific point of view because they give us a

way to put something inside the body that we can manipulate at a distance," says Carlos Rinaldi, Ph.D., the Charles A. Stokes professor and senior associate chair of the department.

With projects under way that could change the way conditions such as cancer and osteoarthritis are treated and help scientists find new ways to direct cell signaling and deliver drugs inside cells, UF biomedical engineering researchers are at the forefront of this work. Supported with funding from the National Institutes of Health, the National Science Foundation and more, UF researchers are leading projects with collaborators across campus and the country.

"We are one of the strongest teams nationally in terms of nanomagnetism," said Christine E. Schmidt, Ph.D., the Pruitt Family professor and chair of the J. Crayton

Pruitt Family Department of Biomedical Engineering. "UF is really poised to make an impact in this area."

New technologies

It was the work of one of the department's own professors that helped pave the way for some of today's exciting applications of magnetic nanoparticles and to the explosion of this field. Jon Dobson, Ph.D., a professor of biomedical engineering in UF's Herbert Wertheim College of Engineering, was one of the early workers in the field. He has made seminal contributions to the application of magnetic nanoparticles to manipulate cell surface receptors and deliver genes into cells. He has also worked to expand the field by writing many reviews that are accessible to the broad interdisciplinary audience of scientists working with magnetic

nanoparticles. In fact, his 2003 paper in the *Journal of Physics D: Applied Physics*, written with collaborators from the U.K. and Australia, laid out the physical principles of many of the biomedical applications of magnetic nanoparticles. The paper has since gone on to become one of the most influential and highly cited articles in the field.

"After that paper, more people started to understand the possibilities," Dobson said. "Once the physical principles were laid out, people's imaginations took off and new applications came at a rapid pace."

Although his initial focus was on geomagnetism in rocks, Dobson's attention shifted while earning his Ph.D. at the Swiss Federal Institute of Technology. In 1987, his brother was diagnosed with brain cancer, and Dobson began thinking about the brain's own magnetic properties and wondering what role these might play on brain cancer.

He began collaborating with a neurologist and other experts and was granted five years of funding to continue studying magnetic iron compounds in the brain and the effects of magnetic fields on the brain.

Years later, after collaborating with UF researcher Chris Batich, Ph.D. while on sabbatical, Dobson returned to his alma mater, UF. Here, his lab is focused on several key projects, including developing technologies to better understand the relationships between iron compounds in the body and certain diseases.

"The big thing to come out of that is some of these iron compounds have strong magnetic properties," he said. "They have the potential to act as natural contrast agents that could aid in MRI-based early detection technologies."

He and his team are also using

magnetic nanoparticles to control cell signaling, a technique he invented in the 1990's and is now attracting attention for applications in tissue engineering and regenerative medicine. By attaching specific molecules to the surface of a magnetic nanoparticle, it can latch onto a cell's receptors. From there, it can do just about anything a scientist wants it to do. "You can control cellular behavior. You can flip a magnetic switch and tell a stem cell to turn into cartilage, almost like a remote control," he said. Normally, this type of influence on cells is gained with chemicals, but molecules are hard to control, he says. Using a

With colleagues in the U.K., Dobson formed two start-up companies. One of the companies commercialized a device that helps scientists use magnetic fields shepherd genes into cells. Another company designs and builds devices used in what is known as "magnetic hyperthermia," where particles are directed to use heat to destroy tumor cells.

Dobson's company in the U.S., with UF colleagues Peter McFetridge, Ph.D., an associate professor of biomedical engineering, and Blanka Sharma, Ph.D., an assistant professor of biomedical engineering, is working to market a system for magnetically



magnetic field gives scientists more of a command.

Dobson's discoveries are now being sold through spin-off companies to help other researchers applying magnetic nanoparticles to solve medical problems.

delivering growth factors to the body. Ever the innovator, Dobson has his eye on other projects as well. An ultimate goal would be to develop the first generation of magnetically controllable artificial cells.

"I'd like to see if we can make artificial

cells that can do things without normal cell machinery,” he says.

Ready to help someone

During his first lecture as a professor at the University of Puerto Rico, Mayagüez, Carlos Rinaldi, Ph.D., presented 15 slides. Because he was an expert on fluid mechanics and theoretical modeling, the first 14 slides were equations about the suspension of nanomaterials. He added one slide in at the end about applications of these theories.

“At the end of the lecture, two students came up to me and said, ‘We don’t want to talk about the first 14 slides; we want to do research on applications of magnetic nanoparticles,’” Rinaldi said. “That’s when I realized I needed to work on applications. That’s how I started making particles and working on their biomedical applications.”

Rinaldi, who joined the UF faculty four years ago, now focuses much of his time on devising ways to manipulate nanoparticles to treat cancer.

Devising treatments that target tumors while doing as little damage to healthy tissue as possible has long been a challenge for researchers focused on cancer. This is where nanoparticles excel. A nanoparticle can creep inside a cancer cell, waiting next to crucial cellular machinery. Once the nanoparticle is in place, Rinaldi can apply what’s called an oscillating magnetic field. This basically means the magnetic field increases and decreases in intensity over time, causing the nanoparticle to heat up, significantly more than its surroundings. He calls this technique nanoscale thermal therapy.

“We are working now to translate this into preclinical models,” Rinaldi

“One of the things that was exciting to me about coming here was creating a critical mass to become leaders in the biomedical application of magnetic nanoparticles,”

- Carlos Rinaldi, Ph.D.



said. “We have done it *in vitro* in cells, but we want to see if this has the potential to be used in humans.”

The team is also collaborating with researchers at the University of California, Berkeley to develop better tools that will help them see what is happening in the body during this process and ensure they are applying the oscillating magnetic fields only to the areas they want to heat. Rinaldi is collaborating with other UF researchers to employ a similar approach to delivering therapeutic drugs to cancer cells. However, instead of directing a nanoparticle to slowly heat a cancer cell to death, the particle will release a drug in response to an oscillating magnetic field to help kill the cancer cell without harming other organs and tissues.

“The problem when we deliver drugs systemically is that the drug goes everywhere and can cause toxicity in all tissues,” Rinaldi said. “But if you have a particle that releases only at the tumor site, that has the potential

for being able to help patients without causing toxic effects.”

Of course, to make all these projects work, Rinaldi and other researchers have to first create nanoparticles that will stay inside the body, engineering the surface of these particles so they are equipped to work with the cell — and then devise ways to move them magnetically.

Luckily, Rinaldi says UF has not only the infrastructure to help make this possible, but also researchers with a broad range of expertise in creating novel magnetic materials and modeling and analyzing their behavior in biological systems.

“One of the things that was exciting to me about coming here was creating a critical mass to become leaders in the biomedical application of magnetic nanoparticles,” he said.

“Every year I have been here has ended in great things.”

“Fourteen years ago when I started, I remember telling my students that for my Ph.D., all I did was derive equations. Now I want to hold something in my hand and think, ‘My group did this.’ Now the bar is even higher. I want to get something in the clinic and help someone.”

Unlocking the cause of pain

Inside the tiny joints of the fingers, a jelly-like substance helps you to type on your phone, pick up a pushpin or any of the other thousands of mindless tasks you don’t realize you do —until it becomes impossible to do them.

To better understand a disease like osteoarthritis, which is characterized by pain and inflammation in the joints, scientists need to sample a substance called synovial fluid. But



taking it out is tricky at best and most often impossible. First, the amount of it inside most joints is small, and synovial fluid is often a precious commodity for people with osteoarthritis, especially in small joints like the fingers.

But like a tiny spy collecting intel, a magnetic nanoparticle can slip through pores and work inside the joint. And much like real-life spies, these particles are sent in with a specific mission. The mission, should each particle choose to accept it, is simple: Find the protein or biomarker researchers are looking for and bind to it, says Kyle Allen, Ph.D., an assistant professor of biomedical engineering.

Then, instead of trying to draw out the thick jelly-like synovial fluid to test, the researchers have a much simpler task: use a magnet to pull out the nanoparticle and its protein intel. “The tool is basically a small, magnetic needle,” said Allen, who received a \$1.6 million grant from the National Institutes of Health’s National Institute of Arthritis and Musculoskeletal and Skin Diseases to fund the project. “It goes in like a needle placed into the joint and

attracts the magnetic nanoparticle.”

Understanding what biomarkers are in joints is crucial for Allen, whose work is focused on understanding the root cause of pain and disability in people with osteoarthritis and finding ways to stop it.

Although researchers have long hypothesized that cartilage damage inside joints is the primary cause of pain and disability in people with osteoarthritis, this has turned out not to be the case, Allen says. “That is the question we are trying to answer; not what is causing degeneration in joints, but what is causing pain and disability. There are a lot of guesses and a lot of theories as to what is happening. But since more cartilage damage doesn’t necessarily mean more pain, other factors, such as joint inflammation may better explain

By using nanoparticles to extract proteins and not the fluid itself, scientists can not only measure biomarkers, but also assess how a new drug therapy is working, without further hurting a joint by taking away much-needed fluid.

a person’s pain or disability,” Allen said. “In order to understand what is causing joint pain, we need to understand what is happening in the joint on a molecular level.”

By using nanoparticles to extract proteins and not the fluid itself, scientists can not only measure biomarkers, but also assess how a new drug therapy is working, without further hurting a joint by taking away much-needed fluid. Scientists can also learn a lot about what is happening inside a joint by studying how nanoparticles move through the joint when guided by magnetic fields, Allen says.

For Allen and his team, magnetic nanoparticles are just one tool they are using to reach their ultimate goal — to find better treatments for people with osteoarthritis. Currently, most of the medications used to treat the disease only mask symptoms, such as pain, without working to stop the disease itself.

Allen is also very interested in the work of his colleagues and the impact it could have on patients with osteoarthritis, particularly a collaboration with Dobson and Rinaldi. Here, the researchers are developing ways to deliver therapeutic agents directly to cells. “If you could take anti-inflammatory medications and

deliver them to the joint, that could be pain-relieving and affect the disease exactly when it’s needed,” he said. “That is a very exciting area in terms of its potential impact on the disease.”

Inspiring Creative Thinking in Future Engineers

Imagine receiving a box of regular household items— a few popsicle sticks, paper clips, scissors and a stapler— and then being asked to build prototype devices to address pressing biomedical challenges.



That's what happens when teachers and students come to the University of Florida to learn biomedical engineering concepts through the UF Center for Precollegiate Education and Training (UF-CPET) programs. UF-CPET partners with educators and students as a vehicle to get STEM education to the public. One of those educators is Dr. Gregory Hudalla, an assistant professor in the J. Crayton Pruitt Family Department of Biomedical Engineering. As part of a five-year NSF CAREER award, Hudalla is creating training modules for teachers and high school students in science classes through an innovative STEM curriculum that exposes them to biomedical engineering design challenges.

STEM is based on the idea of educating students in four specific disciplines — science, technology, engineering and mathematics — in an interdisciplinary and applied approach. UF-CPET allows students to become problem solvers. Students use structured approaches, like the engineering design process, and employ critical thinking. As teachers and students learn and discover together, education becomes more engaging.

The Hudalla Lab collaborates with UF-CPET to integrate these modules into three training programs, two of which focus on high school students. The Science Quest program for 10th graders is designed to stimulate interest and appreciation for the range of career opportunities in science and



Hudalla's modules engage students and teachers using hands-on challenges to solve biomedical problems ranging from drug delivery to joint replacement by fabricating different prototype devices from a single box of common goods. In one instance, teachers and students are tasked with developing catheters to remove plaque buildup in arteries. The teachers and students are briefly

removal, vessel damage, and number of components. Students and teachers are then shown an example of a balloon catheter, which represents the clinical state-of-the-art. Finally, they are tasked with suggesting revisions to improve their prototypes, which completes the engineering process of design, build, test, evaluate, and repeat.

“When I saw the box of materials, I didn’t understand how we could solve such an important issue, but we did. Dr. Hudalla’s training module gave me chills. I can’t wait to go back and teach this to my students”

— Johanna Bauman, science teacher at Eau Gallie High School in Florida

engineering. Explorations in Biomedical Research (EBR) is a two week summer program for students entering 11th and 12th grade that focuses on clinical translation of research. The Biomedical Explorations: Bench to Bedside program gives high school teachers first-hand experience in learning modules that they can then bring back to their classrooms.

introduced to the circulatory system, and a model of Play-doh and tubing is then used to demonstrate plaque buildup. Participants are then given three criteria for prototype design: 1) efficiently remove the plaque — yellow Play-doh, 2) without damaging the vessel — red Play-doh, 3) using the least number of components. Prototypes are assessed for plaque

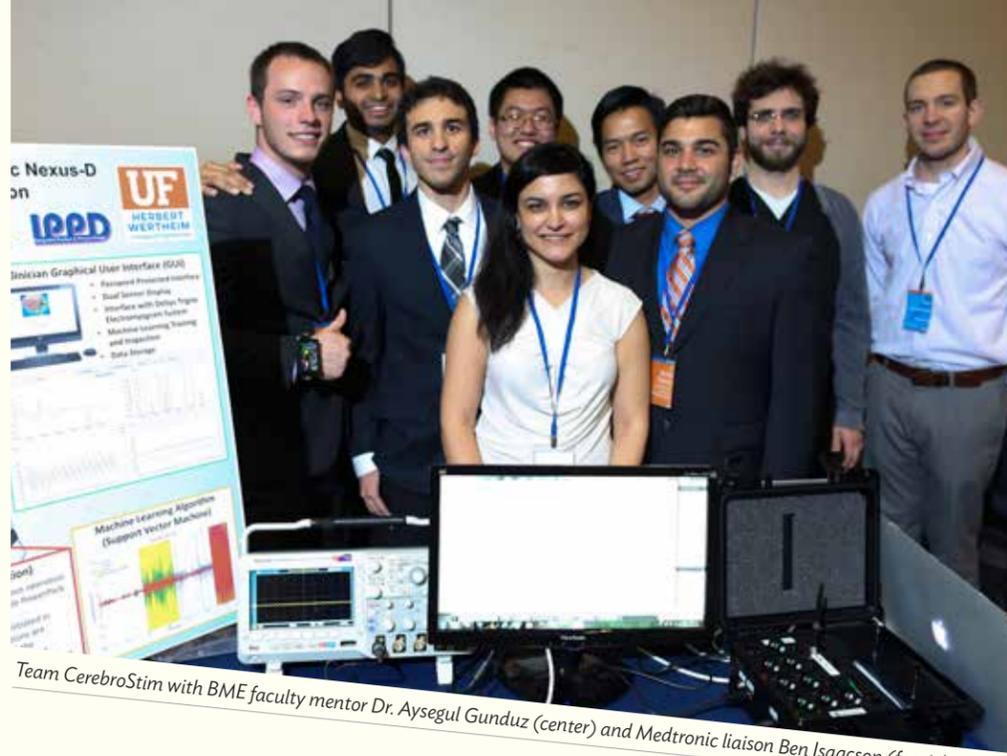
“When I saw the box of materials, I didn’t understand how we could solve such an important issue, but we did. Dr. Hudalla’s training module gave me chills. I can’t wait to go back and teach this to my students,” said Johanna Bauman, a science teacher at Eau Gallie High School in Florida. “My students aren’t aware that biomedical engineering even exists or is a career option for them. This is life changing as far as how I approach teaching my students.”

“Our overarching goal is to get the students thinking about innovation. You don’t always have to come up with something entirely new to solve biomedical problems. The field of BME has largely been built on taking things that already exist and finding a way to repurpose them. For educators, our engaging, professional development model provides tools to empower students to innovate by transforming the classroom into a collaborative space where content comes to life,” said Hudalla.

Engineering Seniors & Medtronic Close the Gap on Suppressing Tremors

When it comes to essential tremor, medication and therapy have played a limited role in treatment and management. But a new research study could change the game for those with the neurological disorder, and it will help thousands ease symptoms and improve their quality of life.

This past spring, undergraduate seniors in The J. Crayton Pruitt Family Department of Biomedical Engineering partnered with global medical technology company Medtronic to research suppression for essential tremor in patients. The partnership was part of the Herbert Wertheim College of Engineering's Integrated Product and Process Design (IPPD) program that provides engineering students with the experience of designing and implementing a product that has been identified as an industrial need. The specific goal for the team, called CerebroStim, was to incorporate clinical wireless sensors that can detect muscle activity acceleration and inertia and



Team CerebroStim with BME faculty mentor Dr. Aysegul Gunduz (center) and Medtronic liaison Ben Isaacson (far right)

integrate them with Medtronic deep brain stimulation (DBS) systems in order to deliver stimulation only when a patient is having a tremor.

CerebroStim was mentored by Dr. Aysegul Gunduz, an assistant professor in BME, who will conduct a clinical feasibility trial of the system developed by the team on patients with essential tremor after regulatory approval next year.

The six-student team consisted of Jackson Cagle, a current BME graduate student, as well as two electrical engineering and three computer science students. The students used an electromyogram (EMG), to measure the electrical activity of muscles at rest and during contraction. This procedure allowed the team to assess the health of muscles and nerves in the body. Once these sensors detected any motion or tremor they communicated with the DBS system and turned it on through wireless communication.

In patients with the most progressive and severe symptoms that are resistant to medical therapies, surgical interventions such as DBS are available. However, the symptoms of essential tremor are not constant. And therefore, constantly stimulating the brain with the same signal is not the most effective treatment. In this new closed-loop approach, brain activity is recorded and fed to a neuroprosthetic device, which then adjusts the

stimulation strength.

This effort is significant because closed-loop DBS is expected to bring about improved treatment of essential tremor by providing adaptive, therapeutic stimulation only when necessary, minimizing undesirable side effects related to DBS, prolonging battery life, and providing more effective tremor suppression

“Students gain the skills and experience that can launch them into successful careers, while industry partners gain access to tomorrow’s engineers, today,” Gunduz says.

Gunduz pushed her team hard over the past two semesters, along with her graduate BME student Enrico Opri, who helped coach the team. Cagle experienced firsthand the need for biomedical engineers with extensive human physiology training in product development teams at medical companies.

“They came into their own as true engineers. They overcame their diversity, they overcame their busy schedules, and they figured out how to deliver a final working product just on time,” Gunduz says. “We were all ecstatic at the end.”

Moving Inventions Beyond the Lab

By Alisson Clark | UF NEWS

Shirley Pincus woke up in her hospital bed and waited for the pain.

Years of failed surgeries had eroded her optimism. The pain always came back. A nerve block hadn't helped. Amputating the tips of two toes didn't, either. A nerve-repair technology invented by University of Florida scientists had given her a glimmer of hope, but after more than seven hours of surgery at a Chicago hospital, Pincus steeled herself for the possibility of another disappointment.

The human-resource manager's left foot started aching in 2008. Within months, the pain became debilitating. She and her husband used to hike and walk on the beach, but now she could barely make it through the workday. “Every day around 2 p.m., I braced myself for the white-hot, stabbing, throbbing, jolting pain that would come,” she said.

Years went by. Treatment after treatment yielded no improvement. Then one night in 2013, she came home from work and got into bed, the pain too overwhelming for anything else. She took out her iPad and started searching for anything that might help. That was when she found two doctors who offered the UF-developed nerve graft, which is made from cadaver tissue.

Nerve transplants from a patient's own body have a major drawback: The area where the donor nerve is taken loses feeling. Cadaver nerves eliminate the need for a donor site, but face some obstacles of their own. A thousand miles apart, two scientists were tackling those hurdles from two different angles. UF biomedical engineer Christine Schmidt – then with the University of Texas at Austin – had discovered how to strip away the parts of the donor nerve that spurred an immune response without destroying the nerve's microarchitecture.

“If inventions don't get into a clinic or the commercial sector, in a sense, what's the point?”

– Christine Schmidt, Ph.D.

In Gainesville, UF pediatrician and neuroscientist David Muir had figured out how to remove the components that inhibited the nerve's regeneration. Together, the two breakthroughs made it possible to transplant cadaver nerves. There was just one problem. “It was too applied,” Schmidt explained. “It wasn't exciting to the scientific community.”

The story might have ended there if it weren't for UF's Office of Technology Licensing, which connects investors and entrepreneurs with UF inventions, launching more than 175 biomedical and technology startups since 2001. One of those companies was AxoGen, which licensed the nerve-regeneration technology and brought it to market. Setting up in UF's



Shirley Pincus has benefited from a collaboration between BME and partner AxoGen.

Schmidt feared the discovery had hit a dead end. There wouldn't be any big grants to take the finding from the lab to the operating room, where millions of patients like Pincus needed it. “If inventions don't get into a clinic or the commercial sector, in a sense, what's the point?” Schmidt said.

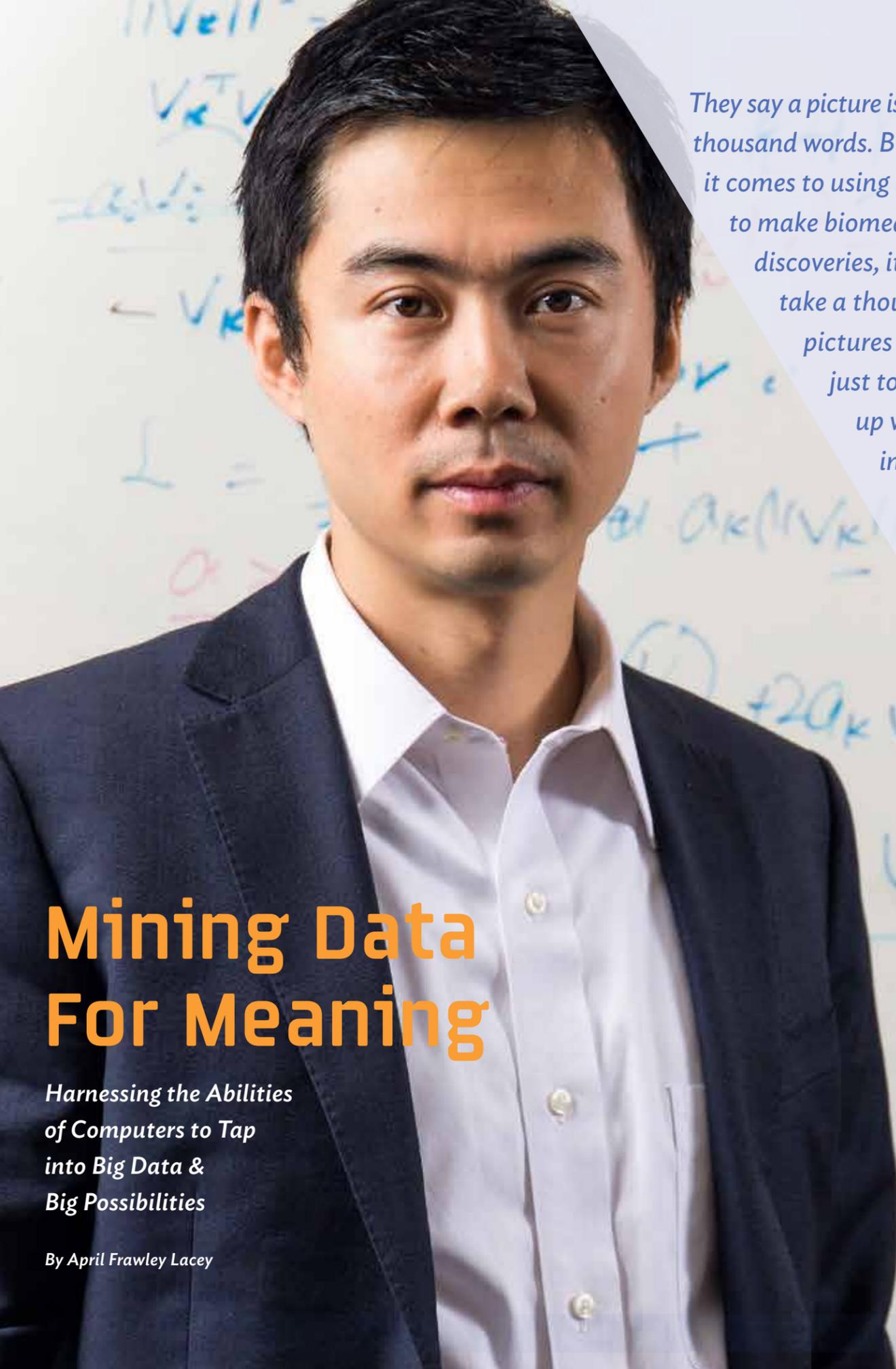
Sid Martin Biotechnology Incubator jump-started their progress, said AxoGen CEO Karen Zaderej. Instead of spending six months finding an office and equipment, their scientists were in labs within a month.

Zaderej was speaking at UF's Celebration of Innovation, where startups based on UF technologies courted potential investors. She shared the stage with some of the people who helped bring the nerve graft to market, including Christine Schmidt and an investor whose company had funded AxoGen. At the other end of stage sat Shirley Pincus, who recounted the day two years ago that she woke up after receiving three of AxoGen's grafts and waited for the pain to return.

It never did.

“The pain that had plagued me for five or six years was gone in a day,” she said.

“Thank you so much.”



They say a picture is worth a thousand words. But when it comes to using images to make biomedical discoveries, it could take a thousand pictures or more just to come up with one innovative finding.

Mining Data For Meaning

Harnessing the Abilities of Computers to Tap into Big Data & Big Possibilities

By April Frawley Lacey

For example, if one study on muscle injury yields thousands of images, it would take a researcher three months to comb through all that data and generate meaningful results.

A machine, however, can do the same analysis in less than an hour, processing one image with 1 million pixels in less than one second, says Lin Yang, Ph.D., an associate professor in the department of biomedical engineering and an expert on harnessing machine-learning and big data to unlock complex discoveries found in biomedical images.

For Yang, who joined the UF faculty in 2014 as part of the UF preeminence initiative, machines are key partners, fellow researchers with unique strengths necessary to push the boundaries of discovery. For example, while one collaborator may be an expert in biomedicine and another an expert in theoretical mathematics, a machine is an expert in its own right, able to deeply mine and search through a rich database at a pace humans cannot match — and make connections a human may not be able to make.

“We want the machine to be another eye to help us to see, another brain to help us to think and to help us discover something we [could] never discover before,” Yang said.

Yang’s lab — machines and humans alike — is currently focused on several key collaborations with researchers across UF and across the country.

One such project involves teaming with more than twenty institutions to find image markers for muscle diseases. By combing through large data sets of images, the researchers have been able to identify image markers that could help doctors distinguish different types of muscle diseases.

The team is also collaborating with H. Lee Sweeney, Ph.D., director of the UF Myology Institute; Karyn Esser, Ph.D., associate program director for the Myology Institute; and UF researchers Glenn Walter, Ph.D.; Krista Vandeborne, Ph.D.; and Barry Byrne, M.D., Ph.D. to develop advanced machine learning and biomedical image analysis systems that muscle researchers can use to make analyzing muscle images a more painless process, and one that can help advance new discoveries.

Called “MuscleMiner,” the tool is the first cloud-enabled imaging and informatics application to not only help researchers analyze images collected from skeletal muscle tissue more quickly, but also help them discover novel new characteristics associated with muscle diseases, Esser said.

Some of the features that will make MuscleMiner particularly useful for researchers, she says, are the abilities it gives them to archive images, query a database of images, and mine the large data sets of images to make connections that would not have been possible before. Yang has also been working closely with Darin Falk, Ph.D., an assistant professor in the College of Medicine and researcher with the Child Health Research Institute and Powell Gene Therapy Center, providing informatics analysis regarding motoneuron and muscle cell connections in models of muscle diseases.

“These informatics tools are exciting and hold significant potential for members of the Myology Institute and the larger population of muscle researchers and clinicians,” Esser said. Yang is also excited about a new project he and his team are

working on with Jong Taek Kim, M.D., associate chief resident of pathology at UF Health.

Working with Kim and other pathologists, Yang’s team is teaching a computer how to think like a doctor using award-winning deep learning algorithms they recently developed.

Yang’s goal is for the computer to be able to tackle medical problems just like a physician, and explain the reasons for its conclusions, too, rather than give simple yes or no answers. “This is when people will really treat artificial intelligence seriously, when a machine can defend their thoughts like human beings,” he said. “I want the computer to see better, think better and help better. Once in a while I

feel astounded by the rapid progress of artificial intelligence. How to better tackle real world and biomedical problems is what drives me and makes me super excited.”

“I feel so lucky to be able to work in this fascinating field for the past 15 years,” he said, “and to continue to do so throughout my entire future career.”

A machine is an expert in its own right, able to deeply mine and search through a rich database at a pace humans cannot match — and make connections a human may not be able to make.

Alumnus Powering the Local Economy



On a mission to provide patients and surgeons with innovative implant solutions that transform individual lives, Todd Goede helps lead the Global Research and Development Group at RTI Surgical, one of UF BME's industry partners and a global leader in surgical implants.

and the ability to take on larger challenges using a step-by-step thought process," Goede says.

After graduation, Goede joined the Cordis Corporation, a Johnson & Johnson company where he began his career as a new product development engineer designing balloon catheters for coronary artery stent delivery systems. Goede joined RTI Surgical in 2005 and just eight years later assumed the role of vice president of global research and development.

"RTI Surgical's success epitomizes and illustrates the Greater Gainesville region's effectiveness at growing companies from startup to maturity,"

- Gainesville Area Chamber of Commerce

While earning a Masters degree in biomedical engineering from the University of Florida, Goede worked in the Computational Biomechanics lab with UF BME affiliate B.J. Fregly from the Department of Mechanical and Aerospace Engineering. There he developed a model to characterize patellofemoral cartilage degeneration using image processing analysis.

"My grad school experience has helped me tremendously in my career in both project-specific and general ways. I have had the opportunity to work on several cartilage projects at RTI through the years and my work in the UF BME program gave me a definite leg up on those projects. My overall experience helped me learn tenacity

development team into the next era of patent breakthroughs for patients motivates me every day," Goede says.

Building strong relationships with co-workers and customers has been a huge part of his success. "As engineers, we often want to rely solely on what our data

are telling us to make decisions. While basing decisions on solid data and analysis are extremely important, if we have poor working relationships our efforts will often fall short of success. I first experienced this in senior design class, and the principle has proved true many times over in the marketplace," Goede says.

Goede was the keynote speaker for the department's annual Pruitt Research Day this past fall. As a business insider, Goede spoke about building relationships and creating trust with the people you work with. He spoke on the power of experience and how to navigate the business environment to achieve the success you want.

"You need to learn to interact with physicians, scientists and company leaders. You have to find a shared language. You need to put yourself in the shoes of both the scientists and the decision-makers." Goede says. He feels that attitude is everything. "One of the most important steps you can take toward achieving your greatest potential in life is to learn to monitor your attitude and its impact on your work performance, relationships and everyone around you. What attitude did you bring into this meeting? To the conversation? To helping others?" Goede says.

"RTI Surgical's success epitomizes and illustrates the Greater Gainesville region's effectiveness at growing companies from startup to maturity," said Gainesville Area Chamber of Commerce President/CEO Susan Davenport. "As one of our region's largest private-sector employers, RTI Surgical continues to provide highly substantial returns to our region in the form of jobs, innovation and opportunity."

company providing surgeons with safe biologic, metal and synthetic implants. Committed to delivering a higher standard, RTI's implants are used in sports medicine, general surgery, spine, orthopedic, trauma and cardiothoracic procedures and are distributed in nearly 50 countries. RTI is headquartered in Alachua, Fla., and has four manufacturing facilities throughout the U.S. and Europe.

RTI's history traces back to February 1998 when the University of Florida Tissue

Bank transferred its allograft processing operations, related equipment and research and development activities to RTI. This spin off from UF is one of the most successful UF technology transfers to date. RTI became a global company in 2008 after merging with Tutogen Medical® GmbH, creating RTI Biologics®. Most recently, in July 2013, RTI acquired Pioneer® Surgical Technology, a global manufacturer of metal and synthetic implants based in Marquette, Mich., becoming RTI Surgical.



From a small tissue bank at the University of Florida to a global company with four world class manufacturing facilities, RTI Surgical has a history of innovation.

RTI Surgical®, one of UF BME's industry partners, is a leading global surgical implant

Celebrating the Successes of UF BME Industry Partners

Working closely with industry and business, the department is developing a new generation of innovators ready to tackle real-world biomedical problems. We celebrate when our industry partners have exciting news to share!



NEW industry partner!
Sigma-Aldrich sponsors the Sigma-Aldrich annual seminar speaker.

Sigma-Aldrich is a leading life science and high technology company whose biochemical, organic chemical products, kits and services are used in scientific research, including genomic and proteomic research, biotechnology, pharmaceutical development, the diagnosis of disease and as key components in pharmaceutical, diagnostics and high technology manufacturing.



Moving into the clinic
Alafair Biosciences receives FDA clearance to market and sell its tendon product, VersaWrap™ Tendon Protector.

Alafair Biosciences is an emerging medical device company developing a novel suite of products based on a non-cell adhesive hydrogel technology that protects and manages advanced wound healing.



Expanding philanthropy
Exactech and UF expand partnership with the naming of the Exactech Arena at the Stephen C. O'Connell Center, a sports and entertainment complex at UF.

Exactech develops and produces innovative bone and joint restoration products that help surgeons worldwide make patients more mobile.



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Rankings & Recognitions

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BEST VALUE IN PUBLIC COLLEGES

— Kiplinger's Personal Finance, 2016

#1
(tied)

BEST HOSPITALS IN FLORIDA

— U.S. News & World Report, 2016

#6

STARTUP LAUNCHES

— U.S. Association of University Technology Managers, 2013

#14

TOP PUBLIC COLLEGES & UNIVERSITIES

— U.S. News & World Report, 2016

#1

TOP STATES FOR INNOVATION

— Fast Company, 2013

#6

BEST PUBLIC COLLEGES

— Money, 2016

#1

UF SID MARTIN BIOTECHNOLOGY INCUBATOR #1 IN WORLD

— UBI Global, 2013

